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# **High-Frequency Acoustic Propagation and Adaptive Signal Processing: An Integrated Research Program**

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## **LONG TERM GOALS**

The long term goals are two-fold. The first is to develop an improved understanding of how acoustic signals propagate through the ocean and how this propagation effects the characteristics of received acoustic signals. The second goal is to use this improved understanding to improve the ability to quantify the performance of adaptive signal processing algorithms in realistic ocean environments and to develop more capable signal processing algorithms.

## **OBJECTIVES**

The objective of this work is to combine the analysis of high-frequency acoustic propagation with the development and analysis of adaptive signal processing algorithms. The application of current interest is underwater acoustic communications so the research is conducted within that context. The specific objectives are to

1. Develop statistical characterizations of the underwater acoustic channel which are useful for the development and analysis of adaptive signal processing algorithms.
2. Determine the predictability of the deterministic and statistical characteristics of the underwater acoustic channel.
3. Develop techniques to quantify the performance of least squares adaptive algorithms in the presense of realistic acoustic channel fluctuations.
4. Develop new adaptive algorithms which exploit characteristics of the underwater acoustic environment to improve performance.

## **APPROACH**

The approach to the pursuit of objectives 1 and 2 is to combine the analysis of field data with physics based propagation modeling to understand the relevance of environmental factors to the deterministic and statistical characteristics of the acoustic channel. The approach to the pursuit of objective 3 is to extend state-space techniques to handle the problem of characterizing algorithm performance in the randomly varying acoustic channel. Finally, the approach to the pursuit of objective 4 will be to use

the results of objectives 1 to 3 to determine the exploitable features of the environment and the characteristics which are most critical to algorithm performance. Algorithms will then be developed which make use of the features which are both critical to improving algorithm performance and exploitable.

## **WORK COMPLETED**

The work being carried out under this proposal is still in its infancy. As such, work on none of the tasks or objectives is fully complete.

## **RESULTS**

As stated in the "work completed" section, this work is still in its infancy. It is currently premature to report results or conclusions publicly.

## **IMPACT/APPLICATIONS**

When complete, the results of this work will have two primary impacts. It will allow better *a priori* prediction of acoustic communications system performance in realistic ocean environments. In addition, it will make possible the development of improved communications algorithms.

## **TRANSITIONS**

The results of this work will be transitioned to the Very Shallow Water/Surf Zone Acoustic Communications and Navigation effort funded under ONR Grant N00014-99-1-0287 and to whatever program (if any) starts as a follow-on to the MURI AOSN program ( ONR Grant N00014-95-1-1316). Both of these programs involve the development of underwater acoustic communications techniques and will benefit from the results of this work. The results of this work will also be transitioned to any other ONR programs involving the development of underwater acoustic communications algorithms.

## **RELATED PROJECTS**

Some of the experimental data collected under ONR Grants N00014-95-1-1316 and N00014-99-1-0287 will be used in the pursuit of the objectives of this program.